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WEED CONTROL IN FIELD CROPS

By E. L. Knake and F. W. Slife

CIRCULAR 856

UNIVERSITY OF ILLINOIS COLLEGE OF AGRICULTURE
COOPERATIVE EXTENSION SERVICE

This circular gives suggestions for weed control based on research results at the Illinois Agricultural Experiment Station and elsewhere. To assist compliance with federal regulations, we have attempted to include only those chemicals for which the suggested uses have clearance. If the label gives directions for rates, timing, or crop use for any herbicide that differ from those suggested here, follow the directions on the most recent label. The user must accept all responsibility for any use other than as directed on the label.

Trade names have been used in some instances to help identify the herbicide discussed. This does not imply endorsement over other products with the same active ingredient.

Rates of application are given as acid equivalent or active ingredient rather than the amount of commercial product.

For information on specific weed problems contact your county extension adviser or write to the Department of Agronomy, University of Illinois, Urbana, Illinois.

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Weed Control in Field Crops

E. L. Knake and F. W. Slife[1]

WHEN WEEDS COMPETE with crop plants, costly reductions in yields result. Research at the University of Illinois on giant foxtail growing in the row with corn and soybeans has shown how serious this competition is. Where there were 50 foxtail plants in each foot of crop row, the corn yield was 70.6 bushels an acre; where there were 6 plants per foot, the yield was 82.1 bushels; and where there were no weeds in the row, the yield was 93.5 bushels an acre. With soybeans, yields were 27.6 bushels an acre with 50 foxtail plants in each foot of row, 34.6 bushels with 6 weeds, and 38.5 bushels with no weeds.

A combination of good cultural practices and chemical control is most effective for weed control. Good cultural practices include using clean seed, preparing the seedbed properly, making timely cultivations, following a good fertility program, and rotating crops. If weeds are not controlled by these normal cultural practices, chemical weed killers (herbicides) can often be used, more than repaying their cost by increasing yields. Chemical control, however, should not replace cultural practices, but should be used in addition to them.

CHEMICAL WEED CONTROL

Herbicides are divided into two major groups: nonselective, which kill all vegetation in the treated area; and selective, which kill certain plants but not others. Most of the herbicides mentioned in this circular are selective. If applied at the recommended rate, they should control weeds without seriously injuring the crop. For many herbicides, the range of selectivity is narrow. Therefore, closely follow the recommended rate of application to avoid crop injury.

Herbicides are also commonly classified according to the time of application. Pre-emergence herbicides are applied before the crop or weeds emerge. They aid in controlling annual weeds — particularly annual grasses. Post-emergence herbicides are applied after the crop or weeds emerge. They help control many perennial weeds as well as annual weeds.

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[1] E. L. Knake, Assistant Professor of Crops Extension, and F. W. Slife, Professor of Crop Production.

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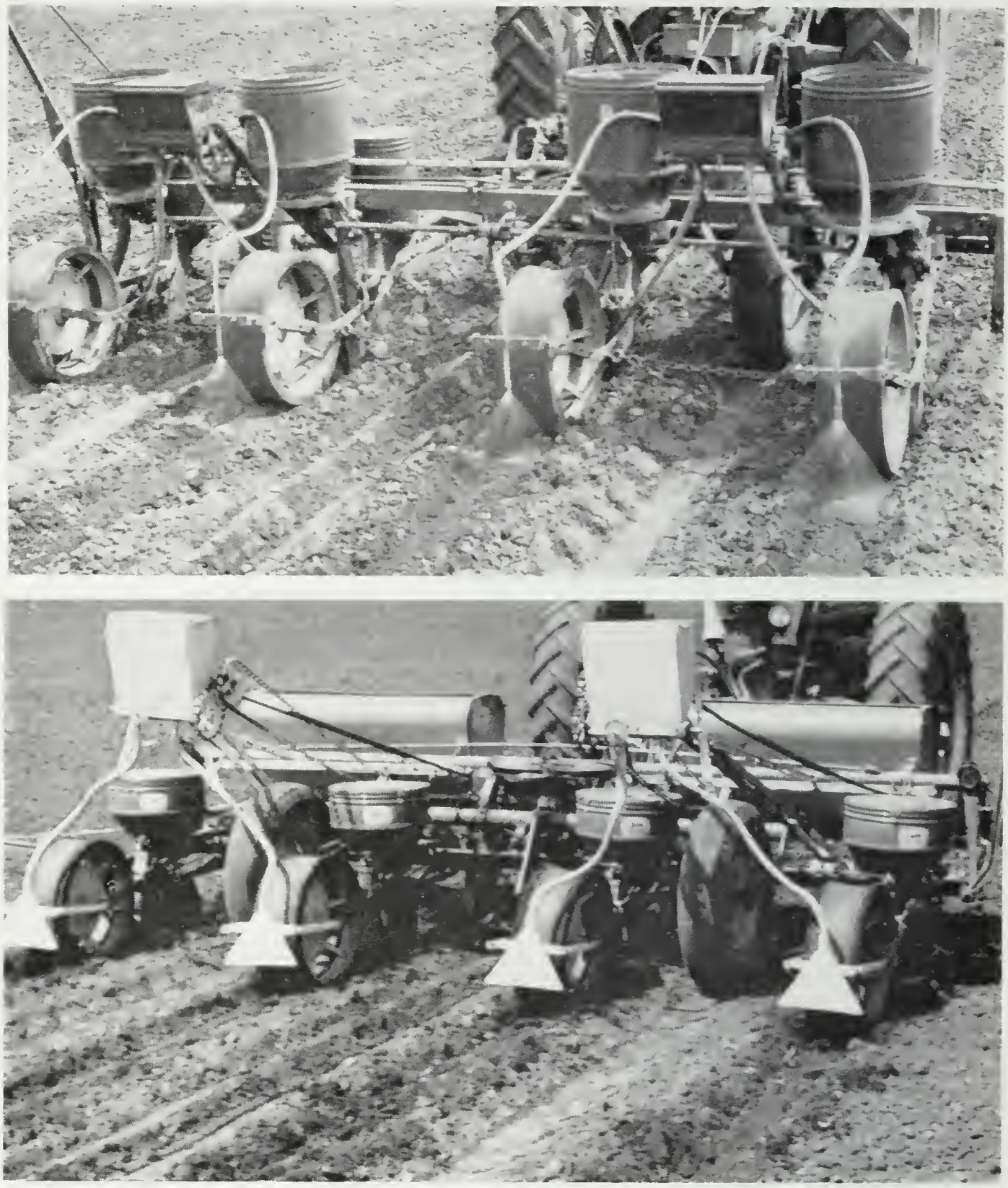


Pre-emergence herbicides are usually applied at planting time in 12- to 14-inch bands directly over the crop row. They may be applied in either liquid (top) or granular (bottom) form.

Amount of water to use. Water serves as a carrier to permit uniform distribution of a herbicide. Regardless of the amount of water used per acre, calibrate so that the correct amount of chemical is applied per acre. To apply pre-emergence herbicides in 12- to 14-inch bands, 7 to 10 gallons of water per acre is usually sufficient. We must rely on rainfall to move the chemical into the soil around the germinating weed seeds.

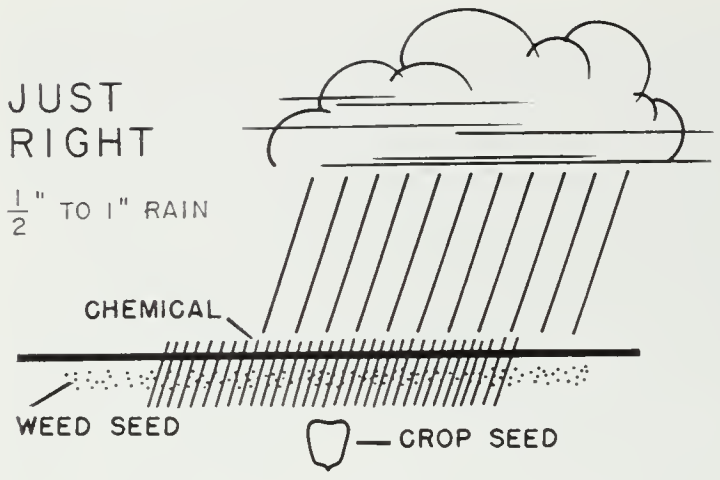
For post-emergence applications in most crops, 10 gallons of water broadcast per acre is usually sufficient. For treating specific weeds such as Johnsongrass, quackgrass, and Canada thistle, it is preferable to use 30 to 50 gallons of water with some herbicides for good coverage of the foliage. In general, the larger and the more dense the weed growth, the greater the amount of water.

Cleaning spray equipment. To avoid damage to susceptible crops, it is best to have spray tanks that are used only for weed-killing materials. It is not advisable, for instance, to use tanks which have had 2,4-D or 2,4,5-T in them for spraying insecticides or fungicides on susceptible crops. If it is not possible to use separate tanks, clean the sprayer thoroughly by draining the tank, pump, hoses, and nozzles. Fill the tank with a mixture of water and household ammonia — 1 cup of ammonia for each 10 gallons of water — and allow to stand overnight. Use a brush to scrub the sprayer where possible. Then drain and flush with clean water.

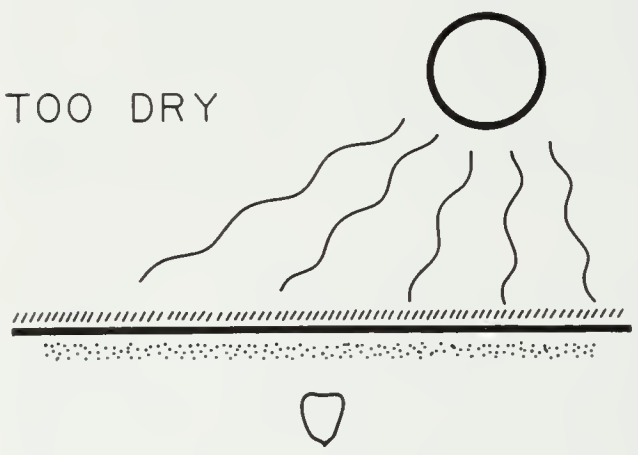
Persistence in soil. Many herbicides will persist in the soil for several weeks or more. Some must do so to kill weeds effectively. The more soluble materials such as 2,4-D probably do not persist in the soil for longer than a month. However, materials of lower solubility such as atrazine persist longer. Even when recommended rates are applied, crops may sometimes be damaged from chemical residues in the soil. Band rather than broadcast application of pre-emergence herbicides and adequate tillage help to reduce the chance of damage to crops from residue. Be careful not to apply too much of a herbicide. When turning on field ends, the applicator should be shut off and no chemical should be flowing from it. When emptying the applicator, be careful not to duplicate coverage.

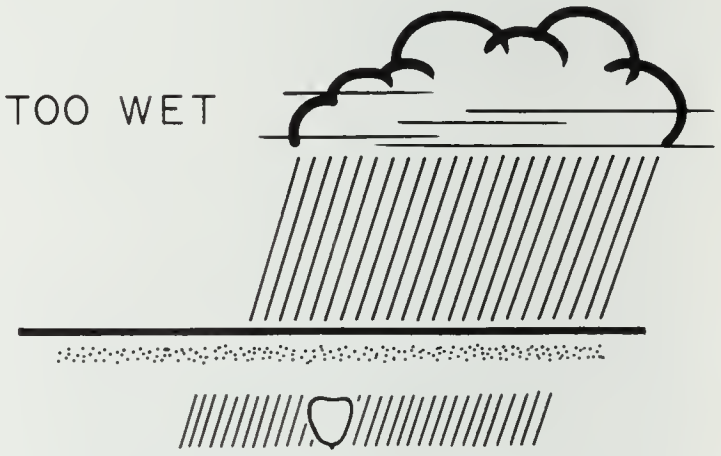
Pre-emergence herbicides. To reduce cost, pre-emergence herbicides are usually applied in 12- to 14-inch bands over the crop row. Conventional cultivation is then used to control weeds between rows.

Effective weed control is not assured for every pre-emergence application. Effectiveness depends largely on weather and soil conditions. If sufficient rain falls to move the chemical into the soil in contact with the germinating weed seeds and very young weed seedlings, the results can be very good. But if the soil stays dry for 2 weeks or more after treatment, the chemical is not moved into the soil, and weeds begin to grow. Too much rainfall, on the other hand, may dilute the more soluble herbicides and wash them too deep so that they are not effective. Some pre-emergence herbicides can damage the crop when leached too deep by excessive rainfall.



Germinating weed seeds are usually located in the upper 1 or 2 inches of the soil surface. Rainfall is needed to move most pre-emergence herbicides into the soil around these weed seeds. Too little or too much rainfall may, however, make the chemical ineffective.





Pre-emergence herbicides may be expected to be effective about three out of four years in Illinois and do offer good insurance in case wet weather prevents timely cultivation. They should especially be considered for fields with a serious annual grass problem, for early-planted fields, and for corn that is not cross-cultivated. If acreages are large, pre-emergence herbicides can help control weeds on those fields to be cultivated last. They also allow more time for other jobs by reducing the time required for cultivation.

Most pre-emergence herbicides come in both granular and liquid forms. Although granules cost about 25 percent more than liquids, some farmers consider them more convenient to handle because no water is required. The irritation caused by some herbicides may be reduced by using granules, but not eliminated.

CORN

Cultural Practices

If conventional tillage methods are used, weeds can be destroyed with a disk, field cultivator, or spring-tooth harrow before planting. With some forms of minimum tillage the space between the rows may be left rough to discourage weed growth.

Some farmers use pre-emergence herbicides only on field edges where weeds are often especially serious.

A good fertility program helps corn get a good start so it can be cultivated while weeds are small. An adequate stand of corn will shade the weeds and compete well with them.

Weeds are usually less of a problem on late-planted fields because corn grows more rapidly with warmer soil temperatures and fewer weeds grow. Check-planting corn allows cross-cultivation to control weeds in the row. About 90 percent of the corn in Illinois, however, is drilled or hill-dropped.

The rotary hoe or harrow is highly recommended for early cultivation. These tools are very effective for killing weeds after the weed seeds have germinated and even before the weeds appear above the soil surface. Once the weeds are 2 or 3 inches high and have established good root systems, the rotary hoe or harrow is much less effective.

The row cultivator is still important for weed control in row crops. The shovels should be set so they throw soil into the row to smother the weeds. Shallow cultivation helps prevent root pruning and brings fewer weed seeds to the surface than deep cultivation.

Pre-emergence Herbicides

If previous experience indicates that cultivation alone will not control weeds, pre-emergence herbicides may be used to supplement cul-

tural practices. Pre-emergence herbicides can be particularly helpful where annual grasses are likely to be a problem in crop rows. Pre-emergence herbicides for corn include atrazine, CDAA (Randox), CDAA-T (Randox-T), and 2,4-D ester.

Atrazine is less soluble than most of the other pre-emergence herbicides and therefore requires more rainfall to be effective. Because it remains in the soil longer, atrazine can provide weed control for almost an entire season if conditions are favorable. Some crops (other than corn) grown the following year may be damaged by atrazine that persists in the soil. Oats are particularly sensitive to atrazine, but injury to soybeans has also been evident. Toxicity to crops other than corn, following application of atrazine for several years, has not been fully determined.

To help avoid residue problems from atrazine, it appears advisable to use spray rather than granular applications and to make band rather than broadcast applications. Before planting other crops, it also appears advisable to follow corn that has been treated with atrazine with another year of corn not treated with atrazine.

Simazine is similar to atrazine except that it is a little less soluble.

CDAA (Randox) is effective on annual grass weeds. Corn has good tolerance to it. Handle Randox carefully to avoid irritating the skin and eyes. The granular form helps reduce but does not eliminate irritation. Randox should be used only on soils that are relatively high in clay and organic matter.

CDAA-T (Randox-T) is a preparation of CDAA and TCBC. TCBC makes possible the control of broad-leaved weeds as well as grasses. However, corn does not have as much tolerance to Randox-T as to Randox, and injury has occurred to soybeans grown the year after corn was treated with Randox-T. It is also irritating and should be handled carefully. Randox-T should be used only on soils that are relatively high in clay and organic matter.

2,4-D ester is the most inexpensive pre-emergence material for corn, but it usually does not perform as consistently as the others and it sometimes damages the crop. Use the ester form of 2,4-D for pre-emergence application since the amine form is more soluble and likely to leach. Do not apply 2,4-D pre-emergence on sandy soil.

Refer to current recommendations for additional information on pre-emergence herbicides for corn.

Post-emergence Spraying With 2,4-D

Post-emergence spraying with 2,4-D is effective only on susceptible broad-leaved weeds and does not kill grasses.

The size of the weeds rather than the size of the corn should be used as the guide to determine when to apply 2,4-D post-emergence. The best time is when the weeds are small. The recommended rate is ¼ pound of the ester form or ½ pound of the amine form per acre.

The amount of acid equivalent is shown on the label. A product that contains the equivalent of 4 pounds of 2,4-D acid per gallon contains 1 pound of 2,4-D acid per quart or ½ pound per pint. One pint of the amine or ½ pint of the ester will be needed for each acre to be treated. Mix the correct amount of herbicide for one acre with water to total the amount your sprayer applies per acre. Ten gallons of spray per acre is usually sufficient.

Precautions

When spraying corn that is more than 8 inches high, equip the sprayer with "drops" extending from the boom down between the rows. This helps keep the spray off the top of the corn thus reducing the chance of damage. It also allows better coverage of the weeds. To avoid overdosage if the nozzles are adjusted to apply the spray into the row and not between the rows, be sure that no more than ¼ pound of 2,4-D ester or ½ pound of 2,4-D amine is applied to the area actually treated.

2,4-D can make corn brittle for 10 days or more, particularly when temperatures are above 85° F. for several days before spraying and corn is growing rapidly. This should not cause a reduction in yield unless breaking and lodging occur. Following an application of 2,4-D, corn of any height may be broken when blown by strong winds or struck by the cultivator. The larger the corn at the time of treatment, however, the greater the chance of getting breakage and lodging due to the weight of the plant. Brittleness is often accompanied by stalks bending at soil level.

Other symptoms of 2,4-D injury are abnormal brace roots and "onion leafing," a condition in which the upper leaves remain tightly rolled and sometimes delay tassel emergence.

Do not use 2,4-D on single crosses and inbred lines of corn since some are very susceptible to it. Most double-cross hybrids grown in Illinois, however, have sufficient tolerance to 2,4-D.

Sweet Corn

Atrazine, Randox, Randox-T, or 2,4-D may be used as pre-emergence herbicides for sweet corn. For post-emergence, 2,4-D may be used at the same rate as for field corn. For corn over 8 inches high use drop nozzles.

2,4-D applied post-emergence in corn is especially helpful for controlling broad-leaved weeds missed by the cultivator (top). 2,4-D does not, however, kill grasses (bottom).

Post-emergence applications of 2,4-D are most effective when weeds are small.

Drop nozzles help keep 2,4-D off the top of the corn. If the nozzles are directed into the row, avoid overdosage by reducing the amount of 2,4-D.

A strong wind occurred a few days after 2,4-D was applied to this field. The stand was reduced as some corn "elbowed" at the base and some broke off.

"Onion leafing" is one symptom of 2,4-D damage.

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SUPPLEMENT FOR USE WITH CIRCULAR 856

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Urbana, Illinois November, 1962

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Prepared by E. L. Knake, Assistant Professor of Crops Extension, and F. W. Slife, Professor of Crop Production.

Band Application of Pre-emergence Herbicides

Crop	Herbicide	Amount of commercial product to apply per acre in 12- to 14-inch band	
		Liquid[a]	Granular[b]
Corn	Randox	1⅓ qt.	7 lb. (20%)
	Atrazine	⅝ to 1¼ lb.	6⅔ to 10 lb. (10%)
	Randox-T	1½ qt.	10 lb. (35%)
	2,4-D ester	½ lb.[c]	3⅓ lb. (20%)
	Eptam	⅔ qt.	20 lb. (5%)
Soybeans	Randox	1⅓ qt.	7 lb. (20%)
	Amiben	2 qt.	
	Alanap	⅔ gal.	14 lb. (10%)
	Sodium PCP	7 to 10 lbs.	7 to 10 lbs. (90%)

[a] For band spraying, use the indicated amount of herbicide in 7 to 10 gallons of water per acre.

[b] The amount listed is for material with the indicated percent of active ingredient.

[c] Actual amount of active ingredient (2,4-D) acid equivalent).

SUPPLEMENT FOR USE WITH CIRCULAR 856

UNIVERSITY OF ILLINOIS · COLLEGE OF AGRICULTURE | COOPERATIVE EXTENSION SERVICE

1963

WEED CONTROL in Field Crops

PRECAUTIONS

Always follow carefully the precautions stated on the label. This will help protect the operator, avoid crop injury, and prevent harmful residues in food and feed crops.

- Use herbicides only on those crops for which they are specifically approved and recommended.
- Use only recommended amounts. Applying too much of a herbicide may damage the crop, may be unsafe if the crop is to be used for food or feed, and is costly.
- Apply herbicides only at times specified on the label. Observe the recommended intervals between treatment and pasturing or harvesting of crops.
- Wear goggles, rubber gloves, and other protective clothing as recommended on the label.
- Guard against possible injury to nearby susceptible plants.

NAMES OF SOME HERBICIDES

Common	*Trade*
amiben	Amiben
amitrole	Amino triazole, Weedazol
amitrole-T	Cytrol, Amitrol-T
ammonium sulfamate	Ammate-X
atrazine	Atrazine
CDAA	Randox
CDAA-T	Randox-T
CIPC	Chloro IPC
dalapon	Dowpon
dinitro (DNBP)	Premerge, Sinox PE
diuron	Karmex
EPTC	Eptam
fenuron	Dybar
fenuron TCA	Urab
linuron	Lorox
MCP	(several)
monuron	Telvar
monuron TCA	Urox
NPA	Alanap-3
simazine	Simazine
sodium chlorate	(several)
sodium chlorate plus calcium chloride	Atlacide
sodium PCP	Weedbeads, Napclor
2,4-D	(several)
2,4,5-T	(several)
4-(2,4-DB)	Butoxone, Butyrac 118

For clarity, trade names have been used in some instances. This is not intended to discriminate against similar products not mentioned by trade name.

1963 RECOMMENDATIONS FOR CHEMICAL WEED CONTROL IN FIELD CROPS

CROP or WEED	CHEMICAL	RATE*	REMARKS
CORN, PRE-EMERGENCE (Atrazine or Randox preferred)	ATRAZINE	2 TO 3 LB.	Controls annual grasses and broad-leaved weeds. Use lower rate on light soils. Do not follow with fall-seeded small grain. Injury to spring oats and soybeans has sometimes occurred the following year. It is recommended that corn be planted a second year with no additional atrazine before planting crops other than corn.
	RANDOX	4 LB.	Controls annual grasses. Prevent irritation to skin and eyes. Do not use on sandy soils.
The following herbicides are also available for corn, pre-emergence, but for crop tolerance and degree of weed control, are less preferable than the above.			
	RANDOX-T	SEE LABEL FOR RATE	Controls annual grasses and most broad-leaved weeds. Prevent irritation to skin and eyes. Some injury may result with heavy rains. Do not use on sandy soils. Injury to soybeans from soil residues has sometimes occurred.
	2,4-D ESTER	1½ LB. LIQUID OR 2 LB. GRANULAR	For control of broad-leaved weeds. May give some annual grass control. Some hazard to corn if heavy rains occur soon after treatment. Do not use on sandy soils.
CORN, POST-EMERGENCE	2,4-D AMINE OR 2,4-D ESTER	½ LB. ¼ LB.	Does not control grass. Use nozzle extensions after corn is 8 inches tall. Amines are preferable to help prevent damage to nearby susceptible crops.
SOYBEANS, PRE-EMERGENCE (Amiben or Randox preferred)	AMIBEN	3 LB.	For control of annual grasses and broad-leaved weeds. Some stunting may occur if heavy rain follows application.
	RANDOX	4 LB.	Controls annual grasses. Prevent irritation to skin and eyes. Do not use on sandy soils.
The following pre-emergence herbicides are also available for soybeans, but for crop tolerance and degree of weed control, are less preferable than the above.			
	ALANAP	4 LB.	Controls annual grasses and broad-leaved weeds. May reduce stand particularly if heavy rain follows application. Does not give good control of smartweeds. A mixture of Alanap and CIPC may be used for smartweed control.
	SODIUM PCP	SEE LABEL FOR RATE	Controls broad-leaved weeds better than grasses. More effective on soils with low organic matter. May cause some injury to soybeans. Dust or spray causes sneezing and is irritating to skin.
SORGHUMS	RANDOX	4 LB.	As pre-emergence — same as for corn.
	2,4-D AMINE OR 2,4-D ESTER	½ LB. ¼ LB.	Apply when sorghum is between 4 and 12 inches high.
SMALL GRAINS, no legume sown	2,4-D AMINE	¼ TO ½ LB.	Apply after grain tillers but before boot stage, not during milk stage. Do not apply in fall to fall-seeded grain. Oats are more sensitive than wheat and barley. Respray in stubble after harvest for control of some perennials.
SMALL GRAIN as companion crop with underseeded legumes	MCP AMINE OR 2,4-D AMINE	¼ LB.	Treat in spring only. Apply after grain tillers and before boot stage, but after small grain and weeds form canopy over legumes. May reduce stand. Do not use on sweet clover.
PASTURE, permanent grass	2,4-D AMINE OR 2,4-D ESTER	½ TO 2 LB.	Amount of 2,4-D depends on weed species to be killed. Retreatment may be required. Will kill or severely injure most legumes.

RECOMMENDATIONS FOR SPECIFIC WEEDS AND WOODY PLANTS

CANADA THISTLE	AMITROLE	4 LB. IN 20-30 GAL. WATER	Apply to spring growth or regrowth when thistles are 6 to 8 inches high to bud stage. Cover foliage completely. Plow at least 2 weeks later and plant to corn. Do not plow before treating. If used in pastures, do not graze for 8 months after treatment. In grain stubble clip and treat regrowth when 6 to 8 inches high.
	2,4-D AMINE OR 2,4-D ESTER	½ TO 1 LB. IN 5-20 GAL. WATER	Apply before thistles bloom. May require 2 or 3 treatments per year. Some strains of thistles not controlled with 2,4-D. Apply on warm, sunny day.
QUACKGRASS	ATRAZINE	4 LB. IN 20-30 GAL. WATER	In fall spray quackgrass any time before ground freezes. Do not work treated area until spring — the later the better. An alternative is to make a spring application either as a single treatment of 4 lb. atrazine at least three weeks before plowing or as a split application of 2 lb. atrazine at least three weeks before plowing and 2 lb. atrazine as broadcast pre-emergence. Following either fall or spring treatment plant only corn for two consecutive years. See label for rates on sandy soils.
	AMITROLE-T	2 LB. (1 GAL.) IN 20-30 GAL. WATER	Apply in spring when quackgrass is 4 to 6 inches high. Wait 10 to 14 days and plow. Plant corn as soon as possible using 2 to 3 lb. rate of Atrazine as pre-emergence.
	DALAPON	6 TO 8 LB. IN 30-40 GAL. WATER	In spring before planting corn or soybeans, apply to quackgrass when 6 to 10 inches high. Plow 7 to 10 days later. Wait 3 to 4 weeks before planting corn or soybeans.
JOHNSONGRASS, old grass	DALAPON	10 LB. IN 30-40 GAL. WATER	Apply in spring before planting corn or soybeans when Johnsongrass is about a foot high. Wait 10 days after treatment to plow. Wait 2 to 3 weeks after plow-down to plant.
JOHNSONGRASS, seedlings	EPTAM (for corn)	3 LB. IN 20-30 GAL. WATER	Apply as pre-emergence when crop is planted. Applying in 14-inch bands will reduce cost. Incorporate into top inch of soil with rotary hoe or harrow. May slightly reduce stand.
	AMIBEN (for soybeans)	3 LB. IN 20-30 GAL. WATER	Apply as pre-emergence when soybeans are planted. Applying in 14-inch bands will reduce cost.
JOHNSONGRASS in small grain	DALAPON	8 LB. IN 30-40 GAL. WATER	Harvest grain, clip or chop stubble, and treat regrowth when 12 to 14 inches high. Fall plow. Plant corn or soybeans the following spring and cultivate frequently to control Johnsongrass seedlings. For pre-emergence, use Eptam for corn or Amiben for soybeans.
JOHNSONGRASS, spot treatments	ATLACIDE	6 LB. PER SQ. ROD	May be mixed with water and used as spray or used dry. Sterilizes the soil for 1 year or more.
JOHNSONGRASS, spot treatments for roadsides, fence rows	DALAPON	1 LB. IN 5 GAL. WATER	Apply when grass is 1 to 2 feet high. Treat again in 3 weeks. (See Illinois Circular 827 for further details on Johnsongrass.)
WILD GARLIC and ONIONS in cornstalks or soybean stubble	2,4-D ESTER	2 TO 3 LB. IN 10 GAL. WATER	Apply in October or November or in late February, March, or early April for bulblet control. Winter-plow if possible, but delay plowing 3 to 4 weeks after treatment. Repeat treatment for 2 to 3 years. Treatment can be used for grass pasture without plowing.
WILD GARLIC and ONIONS in wheat	2,4-D ESTER OR 2,4-D AMINE	½ TO ¾ LB. IN 10 GAL. WATER	Apply in spring after grain has tillered but before boot stage. Will not kill all garlic but plants not killed will usually be distorted so that combine will miss them if wheat is not lodged. May reduce grain yield. May destroy legume underseeding.
GIANT FOXTAIL	Use pre-emergence herbicides when planting corn or soybeans. See Illinois Circular 828 for further details on giant foxtail.		
FENCE ROWS	2,4-D AMINE OR 2,4-D ESTER	½ TO 2 LB. IN 10 GAL. WATER	For broad-leaved weed control. Apply in late spring or early summer when plants are growing rapidly but before blooming. Use extreme care to reduce drift onto susceptible crops or trees and shrubs. Do not use ester form in vegetable crop areas.
	DALAPON	5 TO 8 LB. IN 30-40 GAL. WATER	For grass control. Apply in spring before grass heads out. 2,4-D may be added to control broad-leaved weeds. Completely cover foliage.

CONTROL FOR WOODY PLANTS

FOLIAGE TREATMENT	2,4-D ESTER OR 2,4,5-T ESTER OR MIXTURE OF BOTH	3 LB. IN 100 GAL. WATER	Apply when leaves are full size in spring and before slow summer growth. For mixed brush, use mixture of 2,4-D and 2,4,5-T. For brambles, use 2,4,5-T.
	AMMATE	60 LB. IN 100 GAL. WATER	Apply when leaves are full size, before slow summer growth. Less hazard to nearby desirable plants than 2,4-D and 2,4,5-T. Kills grasses.
BARK or STUMP TREATMENT	2,4,5-T ESTER	16 LB. IN 100 GAL. FUEL OIL OR KEROSENE	Apply in winter or summer to stump or to base of plant from 1 to 2 feet above ground line. Spray until it runs off. For trunks over 5 inches in diameter, apply in frills or girdles.
SOIL TREATMENT	DYBAR OR URAB	1 TBSP. PELLETS ON GROUND TO COVER ½ TO 1 SQ. FT. AT BASE OF EACH TREE OR BRUSH	Readily applied dry any time of year, but late winter or early spring is best. Kills most species of woody plants. Some species do not die until second year after treatment. Do not treat where roots of desirable species grow.

* Rates indicate active ingredient or acid equivalent per acre broadcast.

IMPORTANT: ALWAYS READ AND FOLLOW INSTRUCTIONS ON THE LABEL.

Department of Agronomy, University of Illinois

NAMES OF SOME HERBICIDES

Common	*Trade*
amiben	Amiben
amitrole	Amino triazole, Weedazol
amitrole-T	Cytrol, Amitrol-T
ammonium sulfamate	Ammate-X
atrazine	Atrazine
CDAA	Randox
CDAA-T	Randox-T
CIPC	Chloro IPC
dalapon	Dowpon
dinitro (DNBP)	Premerge, Sinox PE
diuron	Karmex
EPTC	Eptam
fenuron	Dybar
fenuron TCA	Urab
linuron	Lorox
MCP	(several)
monuron	Telvar
monuron TCA	Urox
NPA	Alanap-3
simazine	Simazine
sodium chlorate	(several)
sodium chlorate plus calcium chloride	Atlacide
sodium PCP	Weedbeads, Napclor
2,4-D	(several)
2,4,5-T	(several)
4-(2,4-DB)	Butoxone, Butyrac 118

For clarity, trade names have been used in some instances. This is not intended to discriminate against similar products not mentioned by trade name.

Band Application of Pre-emergence Herbicides

Crop	Herbicide	Amount of commercial product to apply per acre in 12- to 14-inch band	
		Liquid[a]	Granular[b]
Corn	Randox	1⅓ qt.	7 lb. (20%)
	Atrazine	⅚ to 1¼ lb.	6⅔ to 10 lb. (10%)
	Randox-T	1½ qt.	10 lb. (35%)
	2,4-D ester	½ lb.[c]	3⅓ lb. (20%)
	Eptam	⅔ qt.	20 lb. (5%)
Soybeans	Randox	1⅓ qt.	7 lb. (20%)
	Amiben	2 qt.	
	Alanap	⅔ gal.	14 lb. (10%)
	Sodium PCP	7 to 10 lbs.	7 to 10 lbs. (90%)

[a] For band spraying, use the indicated amount of herbicide in 7 to 10 gallons of water per acre.

[b] The amount listed is for material with the indicated percent of active ingredient.

[c] Actual amount of active ingredient (2,4-D acid equivalent).

Prepared by E. L. Knake, Assistant Professor of Crops Extension, and F. W. Slife, Professor of Crop Production.

Urbana, Illinois November, 1962

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PRECAUTIONS

Always follow carefully the precautions stated on the label. This will help protect the operator, avoid crop injury, and prevent harmful residues in food and feed crops.

- Use herbicides only on those crops for which they are specifically approved and recommended.

- Use only recommended amounts. Applying too much of a herbicide may damage the crop, may be unsafe if the crop is to be used for food or feed, and is costly.

- Apply herbicides only at times specified on the label. Observe the recommended intervals between treatment and pasturing or harvesting of crops.

- Wear goggles, rubber gloves, and other protective clothing as recommended on the label.

- Guard against possible injury to nearby susceptible plants.

SORGHUM

Sorghum is usually planted in warm soil one to two weeks later than corn. The seeds do not all germinate at the same time and young plants grow slowly, especially if planted early. This slow growth usually delays the first cultivation longer than for corn. Weeds may therefore be a greater problem.

Randox may be used as a pre-emergence treatment for control of annual grass weeds. It should be used only on soils that are relatively high in clay and organic matter.

Post-emergence applications of 2,4-D may be used at the same rate as for corn to control broad-leaved weeds. Sorghum is most tolerant to 2,4-D when it is 4 to 12 inches high — measured from the ground to where a new leaf is coming out. Injuries similar to those for corn may occur especially when sorghum is in the seedling, early boot, or pollination stages of growth. Use 2,4-D only where the weed problem is serious. Forage sorghums, such as sudangrass, appear to be more resistant to 2,4-D than grain sorghums.

SOYBEANS

Cultural Practices

The first step in cultural control is to prepare a weed-free seedbed. Delay final seedbed preparation and planting until soil temperatures are warm to help the beans get a vigorous start ahead of the weeds.

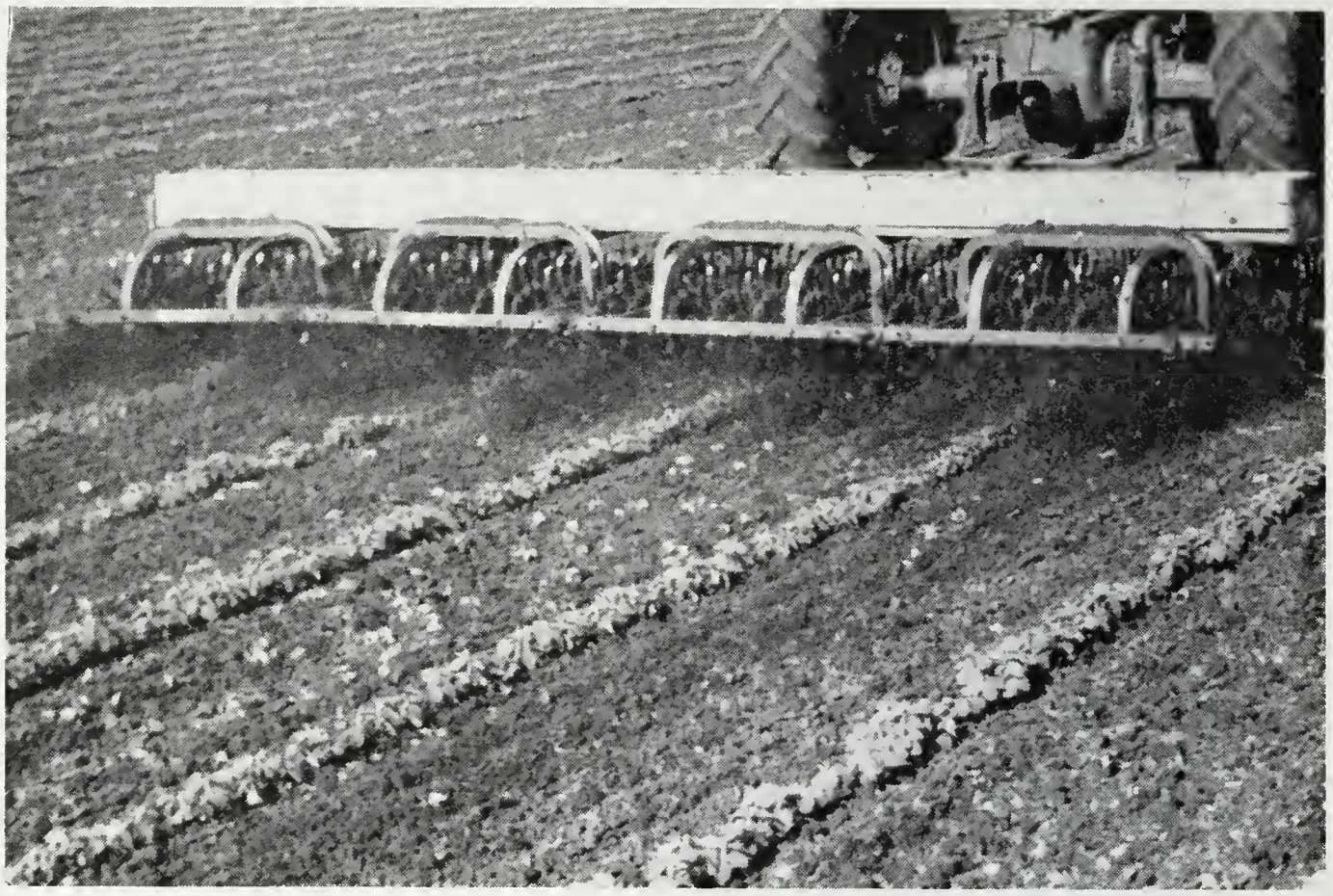
Early cultivation with the rotary hoe or harrow is very effective for killing small weeds. The equipment may be used even before the soybeans emerge. This will destroy weed seedlings and break crusted soil to help the crop emerge. Avoid cultivation during emergence because soybeans are easily injured by cultivation equipment at that time. After emergence there is less danger of breaking the stems if you cultivate during the hot part of the day.

Follow early cultivation with the row cultivator. Cultivate just deep enough to control the weeds. Set the shovels so they throw soil into the row to smother the weeds.

Once early weeds have been controlled and the beans shade the soil, they can compete vigorously with late weeds. This is especially true of beans planted in narrow rows.

Pre-emergence Herbicides

Where grasses or broad-leaved weeds are likely to be a serious problem in soybeans and cultural practices alone will not control them, pre-emergence herbicides are often helpful.



Rotary hoeing is a quick and economical method of killing early weeds.

It may be well to try pre-emergence applications for soybeans on a small acreage for a year or two before attempting them on a large scale. As is true for corn, success of pre-emergence herbicides for soybeans depends largely on weather and soil conditions.

For best results, apply the herbicide when planting, or within two or three days at the most. Attachments may be mounted on the planter to apply sprays or granules directly behind the planter wheels.

Amiben, CDAA (Randox), NPA (Alanap), and sodium PCP are available for pre-emergence use on soybeans.

Amiben, which received label clearance in 1961, controls both annual grasses and broad-leaved weeds in soybeans better than most other herbicides. Soybeans appear to have relatively good tolerance to it although early stunting sometimes occurs.

CDAA (Randox) controls annual grasses but not most broad-leaved weeds. It should be used only on soils that are relatively high in clay and organic matter. Soybeans have good tolerance to it. Handle Randox carefully to avoid irritation. Randox-T should not be used on soybeans since it will kill them.

NPA (Alanap) is effective on annual grasses and most broad-leaved weeds except smartweed. It may damage soybeans particularly when heavy rain follows application. Alanap is not recommended for sandy soils. A mixture of Alanap and CIPC may be used to help control smartweed.

Sodium PCP, which received label clearance for pre-emergence use on soybeans in 1961, controls broad-leaved weeds better than grasses. Since soybeans do not have good tolerance to it, injury sometimes results. Be sure to use sodium pentachlorophen*ate* which is the sodium salt of pentachlorophe*nol* and not pentachlorophenol itself. Handle it carefully since breathing the dust or fine spray particles causes sneezing and irritates the skin. Sodium PCP usually performs best on clay soils low in organic matter.

Refer to current recommendations for additional information on pre-emergence herbicides for soybeans.

SMALL GRAINS

Use of clean seed is basic for weed control in small grains.

A variety with good lodging resistance that can stand well to maturity is able to compete better with weeds than the weak-strawed varieties.

Sow the grain thick enough so it can compete vigorously with weeds. About 2 bushels per acre is sufficient if the seedbed is prepared adequately and the seed is drilled.

Two closely related chemicals — 2,4-D and MCP — are suggested for controlling broad-leaved weeds in small grains. They should not be used where there are legume underseedings unless the weed hazard is serious, because they may damage the legumes. Sweet clover is particularly sensitive to these chemicals; *it should not be sprayed with 2,4-D.* MCP is less injurious to legumes, but 2,4-D is more effective for the control of certain weeds.

Spring Oats, Wheat, and Barley

Apply the amine type of 2,4-D or MCP. If there is no legume underseeding, as much as ½ pound per acre may be applied, although this may reduce grain yields somewhat. Where there are legumes such as alfalfa, red clover, ladino clover, alsike clover, birdsfoot trefoil, and lespedeza, no more than ¼ pound should be used.

The best time to spray small grain is after it has finished tillering in the spring when the grain is about 5 to 8 inches high, just before rapid elongation or "jointing" of the stem begins. Oats are more sensitive to 2,4-D than wheat or barley. Spraying at the seedling, boot, or milk stages, however, results in serious crop injury to all small grains.

If the grain contains only small areas of Canada thistle or field bindweed, spot treatments at the rate of ½ to 1 pound of 2,4-D acid

per acre are suggested. Although this rate will destroy the legume underseeding and probably reduce grain yield in the treated areas, this disadvantage will not be objectionable if the areas are small.

Winter Wheat

In general, winter wheat tolerates 2,4-D better than most spring grains. It should not, however, be sprayed with 2,4-D in the fall.

Where legumes have been seeded with the wheat, ¼ pound of the amine form of 2,4-D per acre is the maximum amount to use. This rate will usually control most troublesome weeds except wild onion and garlic. Spray after the wheat has finished tillering in the spring and before it is in the boot stage. April is usually the proper time.

To control wild onion and garlic, use ½ pound of the ester form or ¾ pound of the amine form of 2,4-D. This amount may slightly reduce the wheat yield, and it will probably destroy legume underseedings. Even this heavy rate will kill only 30 to 50 percent of the wild onion and garlic, but the remaining plants will usually be so distorted that the combine will miss them if the wheat is not lodged.

FORAGE CROPS

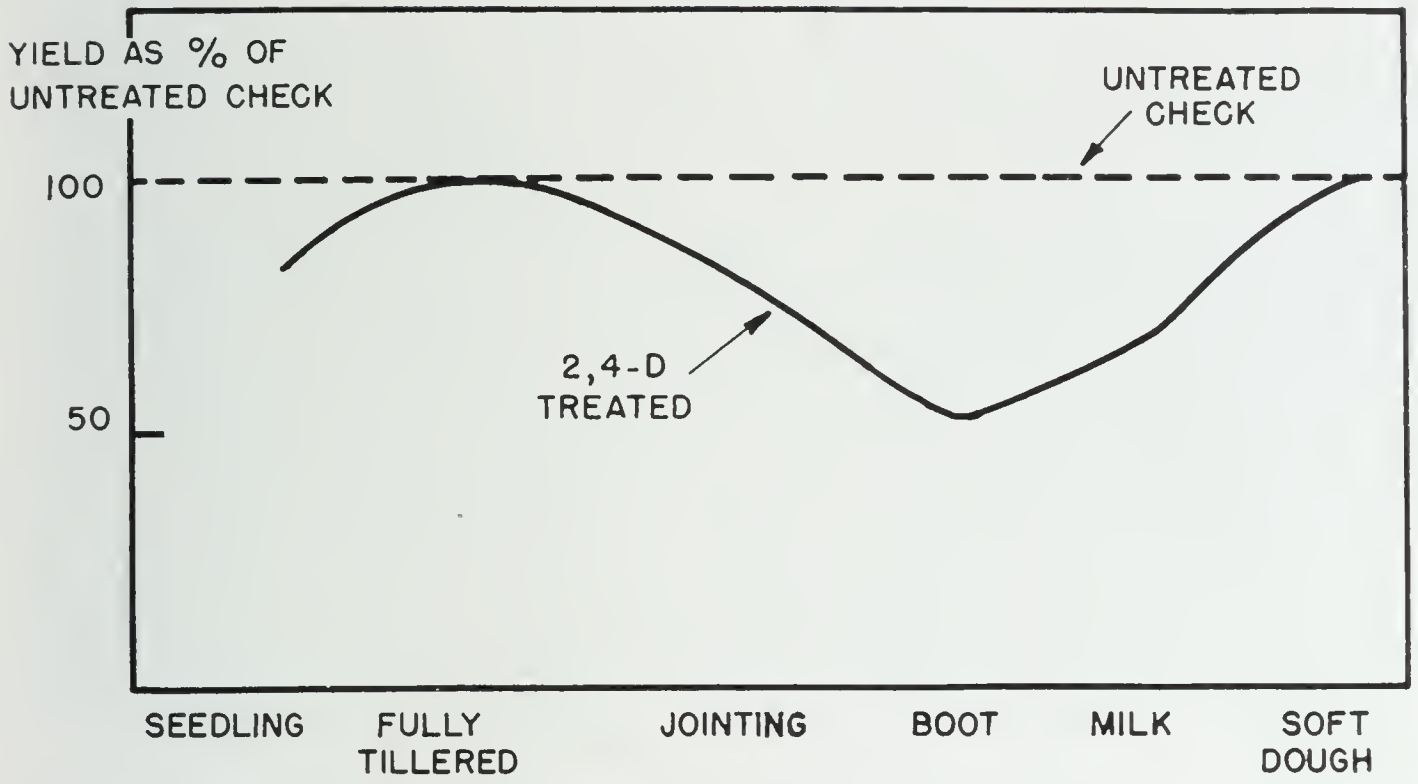
Seedling Legumes and Grasses

Seedling forage crops are generally poor competitors with weeds, but the following cultural practices can help forage crop seedlings become well established: control weeds in row crops of the rotation, follow a good fertility program, prepare a weed-free seedbed, clip forages sown alone except sweet clover, and mow stubble of companion crops and patches of perennial weeds.

Where weeds are a serious threat, seedling stands of alfalfa, red clover, ladino clover, and alsike clover may be sprayed with MCP or the amine form of 2,4-D. Use ¼ pound or less per acre when the companion crop or weeds form a canopy over the legumes.

Working EPTC (Eptam) into the soil before planting at the rate of 3 pounds per acre has given effective control of annual grass weeds in alfalfa, lespedeza, and birdsfoot trefoil when these legumes were sown without a companion crop and without grasses in the mixture. EPTC controls grasses better than broad-leaved weeds. Prepare the seedbed and apply the herbicide on the soil surface. Then disk to a depth of about 2 inches before seeding the legume. Do not graze or feed legumes for 60 days after treatment.

Dalapon and 4-(2,4-DB), used separately or as a mixture, have limited label clearance for controlling weeds in forage crops.



Effect of 2,4-D at recommended rate on yield of weed-free small grains treated at different stages of growth.

The best time to control winter annual weeds in small grain is in the spring when the grain is fully tillered.

Broad-leaved weeds in grass pastures are easiest to control with 2,4-D when the weeds are small. This farmer is making a spring application.

4-(2,4-DB) will control many broad-leaved weeds such as wild mustard, pigweed, and lambsquarter. It may be used on new seedings of alfalfa, red clover, ladino clover, alsike clover, or birdsfoot trefoil, whether seeded alone or with oats, wheat, or barley. Apply ½ to 1 pound of 4-(2,4-DB) per acre when the weeds are 1 to 3 inches high. No portion of a treated crop should be fed to livestock within 30 days of application.

Dalapon has been used successfully to kill young grass seedlings in seedling stands of alfalfa and birdsfoot trefoil that are not seeded with small grain or grasses. Use 2 to 3 pounds of the commercial preparation per acre when weed grasses have about 2 leaves and legumes are 2 to 3 inches high. Forage from the treated area must not be fed to dairy animals or animals being finished for slaughter. The first-year crop should not be sold commercially or shipped interstate.

New grass seedlings of most species may be treated with up to ¾ pound of 2,4-D per acre after they have reached the 2- to 4-leaf stage. Treatment at early heading through flowering may reduce forage grass yield slightly and seed production markedly. The amines are less likely to cause damage than the esters at any stage of growth.

Established Legumes and Grasses

MCP or the amine form of 2,4-D may be used at light rates in legumes such as alfalfa, red clover, ladino clover, alsike clover, birdsfoot trefoil, and lespedeza. Legumes are very sensitive to 2,4-D, so

only the amine form should be used. To avoid serious damage apply 1/8 to 1/4 pound in 10 to 20 gallons of water per acre in the spring while the legumes are in the early dormant state, or immediately after hay harvest. *Do not spray sweet clover with 2,4-D.* This treatment will control sensitive broad-leaved weeds but not grasses.

4-(2,4-DB) may be used at the rate of 1½ pounds per acre to control broad-leaved weeds in established legumes. Do not graze or harvest treated crops for 30 days after treatment. Treating in the fall will control most winter annual broad-leaved weeds.

Pastures

Good management, including controlled grazing, is basic for weed control in pastures. Grasses and legumes can best compete with weeds when adequate drainage is provided and limestone and fertility needs are met. Timely mowing will prevent weed seed production, kill some annual weeds, and weaken or eliminate many perennial weeds. Graze adequately to discourage growth and seed production of weeds, but do not overgraze. Where pastures are extremely thin and weedy, start a good pasture-renovation program.

In perennial grass pastures many broad-leaved weeds can be easily controlled with 2,4-D. The rate needed depends on the kind of weeds. For example, dandelions can be controlled with 1/4 pound of 2,4-D per acre. Two to 3 pounds repeated twice yearly for two years or more may be needed for wild garlic and onion. One to 2 pounds of 2,4-D or a mixture of 2,4-D and 2,4,5-T will control many pasture weeds as well as brush and woody plants without seriously damaging pasture grasses. This will, however, eliminate most legumes in the treated area.

2,4-D CONVERSION TABLE

Pounds of active ingredient per gallon of commercial product	Pints of commercial product needed to give		
	¼ lb. of chemical per acre	½ lb. of chemical per acre	1 lb. of chemical per acre
2.00	1	2	4
2.64	3/4	1 1/2	3
3.00	2/3	1 1/3	2 2/3
3.34	3/5	1 1/5	2 2/5
4.00	1/2	1	2
6.00	1/3	2/3	1 1/3

A mixture of 2,4-D and dalapon may be used in fencerows to control both grass and broad-leaved weeds.

FENCEROW WEED CONTROL

If the vegetation in fencerows consists primarily of broad-leaved weeds, use 2,4-D at the rate of ½ to 1 pound applied in 10 or more gallons of water per acre. Two miles of fencerow four feet wide is equivalent to about an acre.

Make the first application of 2,4-D in May or early June to control early weeds, and make another application in July or early August to control late weeds.

If the fencerow vegetation consists chiefly of woody plants, use a mixture of 2,4-D and 2,4,5-T.

If there are grass weeds such as Johnsongrass or foxtail in the fencerow, dalapon may be mixed with 2,4-D for control of both broad-leaved weeds and grasses. The grasses should be sprayed before seed heads form. Use only 2,4-D where the fencerow vegetation consists primarily of broad-leaved weeds and desirable grasses.

PRECAUTIONS

Always follow carefully the precautions on the label. This will help protect the operator, avoid crop injury, and prevent harmful residues in food and feed crops. If in doubt, consult your county extension adviser.

1. Use herbicides only on those crops for which they are specifically approved and recommended.

2. Use only recommended amounts. Applying too much of a herbicide may damage the crop, may be unsafe if the crop is to be used for food or feed, and is costly.

3. Apply herbicides only at times specified on the label. Observe the recommended intervals between treatment and pasturing or harvesting of crops.

4. Wear goggles, rubber gloves, and other protective clothing as recommended on the label.

5. Guard against possible injury to nearby susceptible plants. In the case of 2,4-D, care should be taken to prevent damage to such susceptible crops as soybeans, grapes, and tomatoes. If it is necessary to spray in the vicinity of such crops, the amine form is safer to use than the volatile ester form. But even with the amine form, spray may drift to susceptible crops. Chance of damage can be reduced by operating sprayers at low pressure with tips that deliver large droplets and high gallonage output. Some farm liability insurance policies do not cover crop damage caused by the ester form of 2,4-D.

Droplets of 2,4-D, MCP, and 2,4,5-T sprays often drift for several hundred yards. Spray only on a calm day or make sure air is not moving toward susceptible crop plants and ornamentals.

NAMES OF SOME HERBICIDES

Common	*Trade*
amiben	Amiben
amitrole	Amino triazole, Weedazol
amitrole-T	Cytrol, Amitrol-T
ammonium sulfamate	Ammate-X
atrazine	Atrazine
CDAA	Randox
CDAA-T	Randox-T
CIPC	Chloro IPC
dalapon	Dowpon
dinitro (DNBP)	Premerge, Sinox PE
diuron	Karmex
EPTC	Eptam
fenuron	Dybar
fenuron TCA	Urab
linuron	Lorox
MCP	(several)
monuron	Telvar
monuron TCA	Urox
NPA	Alanap-3
simazine	Simazine
sodium chlorate	(several)
sodium chlorate plus calcium chloride	Atlacide
sodium PCP	Weedbeads, Napclor
2,4-D	(several)
2,4,5-T	(several)
4-(2,4-DB)	Butoxone, Butyrac 118

WEIGHTS AND MEASURES

1 pound = 16 ounces; 454 grams.

1 gallon = 4 quarts; 8 pints; 128 fluid ounces; 256 level tablespoonfuls; 3,785 cubic centimeters.

1 tablespoonful = 3 teaspoonfuls; ½ fluid ounce; 14.8 milliliters.

1 acre = 43,560 square feet; 160 square rods; an area 208.7 feet square; an area 16½ feet wide and ½ mile long.

1 mile = 5,280 feet; 1,760 yards; 320 rods.

1 rod = 5½ yards; 16½ feet.

SUSCEPTIBILITY OF WEEDS TO 2,4-D

Seedlings or young growth of the following weeds will usually be killed or controlled by 2,4-D at the rate of ¼ to ½ pound per acre. As weeds grow larger they are more difficult to control with 2,4-D. Therefore spray when weeds are small.

Buckhorn
Burdock
Chicory
Cocklebur
Common ragweed
Flower-of-an-hour
Giant ragweed
Hedge bindweed
Jimsonweed
Lambsquarters
Morningglory (annual)
Mustards
Peppergrass
Pigweed
Smartweed
Velvetleaf

The following weeds are not easily controlled with ¼ to ½ pound of 2,4-D per acre. Repeated applications of ½ to 2 pounds per acre may be used in non-crop land or where the crop will tolerate this rate.

Canada thistle
Docks
Field bindweed
Perennial sowthistle

The following weeds have considerable resistance to 2,4-D.

Bullnettle or horsenettle
Climbing milkweed
Common milkweed
Devil's shoe-string (Swamp or perennial smartweed)
Grasses
Groundcherry
Nightshades

DEFINITIONS

Active ingredient — That portion of a chemical formulation that is herbicidally active.

Boot stage — When the head of small grain increases greatly in size while still wrapped in the sheath of the top or "flag" leaf.

Contact herbicide — A herbicide that affects only the tissue in the immediate area of contact and is not translocated to any appreciable extent within the plant.

Drift — Movement by wind of spray as tiny droplets or as vapor during or after application.

Herbicide — A chemical that will kill plants or inhibit their growth.

Post-emergence — The application of a herbicide after the crop or weeds emerge.

Pre-emergence — The application of a herbicide to the soil after the crop is planted but before it or the weeds emerge.

Selective herbicide — A herbicide that is effective on certain plants but not on others, even though all are treated alike.

Volatility — The capacity of a liquid or solid substance to change readily to vapor (gas).

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Readers desiring additional information on weed control may obtain single copies of the following publications from the University of Illinois, College of Agriculture at Urbana or from a county extension adviser:

Weeds of the North Central States. Circular 718. ($1.00)

Band Spraying Pre-Emergence Herbicides. Circular 791.

Prevent 2,4-D Injury to Crops and Ornamental Plants. Circular 808.

Controlling Johnsongrass in Illinois. Circular 827.

Controlling Giant Foxtail in Illinois. Circular 828.

Calibrating and Maintaining Spray Equipment. Circular 837.

Calibrating and Adjusting Granular Row Applicators. Circular 839.

A Dozen Weeds in Your Lawn. Circular 847.

Controlling Poison Ivy. Circular 850.

URBANA, ILLINOIS NOVEMBER, 1962

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